"Design and Devlopment of Advanced Spatio Temporal Database Models"

Research Protocol

For Registration for Ph.D. Programme

Submitted by

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Under the Guidance of

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ANNEXURE-A

Scholar's Basic Information

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Date:17-07-2023 **Signature of the Candidate**

ANNEXURE-B

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RELEVANT CERTIFICATE

This is to certify that this Synopsis entitled -**"Design and Devlopment of Advanced Spatio Temporal Database Models"** submitted by **Garima Jolly** in fulfilment of the requirement for the Ph.D. in "**Computer Applications"** under School of **Computer Applications** of JECRC University, Jaipur, during the academic year 2022-23 is a bonafide record of work carried out under my guidance and supervision. The matter embodied in this synopsis is original in character and has not been submitted to any other university for the award of any other degree or diploma.

Date: 17-07-2023

(Signature of Guide)

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FACULTY OF ENGINEERING
PH.D COURSE WORK
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SUBJECT TITLE	GRADE
RESEARCH METHODOLOGY	B
QUANTIATIVE TECHNIQUES AND COMPUTER APPLICATION	B
QUANTIATIVE TECHNIQUES AND COMPUTER APPLICATION LAB	A
RESEARCH & PUBLICATION ETHICS	A

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INTRODUCTION

This synopsis is primarily focused to store and architect the real world data in a structured format we use the database management system. Time is a persistent feature of real world objects. An event which happens at a particular time of point and the relation between these objects exists when these events happens. The dealing in between these changes can take place and divide them into two types of databases i.e. temporal and the spatial database. The temporal database is a method where the data evolves over time. The spatial database [1], [5] is a method where the data evolves around the location which is changes with the change of time. Space and time varying data represent different states of an object at different instance of time. It provides the seamless approach for the storage of data, and query that data in an efficient way. This spatio-temporal data plays an important role in decision making methods for the framing of long term strategies.

Spatio-temporal data framework enhances existing spatial data by dealing with temporal data. A large number of researches have been made in spatial database. Since the relational database has a solid premise both on theory and application, and it will be expanded, it can likewise be utilized to deal with spatio-temporal information. A social database framework [8], [2] can be utilized to deal with some particular issues in spatio-temporal database. It contains numerous valuable information examples that might be mined. It is moderately simpler to discover those examples in social database by utilizing the information techniques, most of which are focussed on social databases as of now.

This chapter starts with the introduction of various types of database systems. Follow by the change detection in different images at different intervals of time [10]. This section also highlights the various application areas of the spatio-temporal databases. Subsequently, the commitment of the proposal in this database inquire about is incorporated. This includes the point-wise listing of all the major contribution made in this synopsis.

SPATIO-TEMPORAL DATABASE MODEL

Spatio-temporal data model is a methodological approach to detect and describe patterns, trends, and relations in data in both time n space. Temporal database is a database with built-in support for handling data involving time.

TYPES OFTIME AVAILABLE

1. Valid Time
2. Trasaction Time
3. BitemporalTime

VALIDTIME

Valid Time:-valid time is a time period during which fact is true in the real world

Use:- Financial Application-eg. History of stock markets share price, Reservation System-eg, when was flight booked Medical System-patient Records, Computer Applications eg. historyof file backup.

Valid Time Example

Name	Department	Salary	Valid Start Time	Valid End Time
James	PHP	10000	2005	2006
Ben	SEO	20000	2000	2002
Eric	HR	15000	2003	2007

TRANSACTION TIME

Transaction Time is the time period during which a factstored in the database was known.

Use:-To Rollback Database

Name	Department	Salary	TransactionTime
James	PHP	10000	2016
Ben	SEO	20000	2016
Eric	HR	15000	2016

BITEMPORALTIME

Bitemporal Data

- Combines both valid and transactiontime
- It store Data with Respect of Both Valid time &transaction time.
- More Preferable

Name	Department	Salary	TransactionTime	Start time	Endtime
James	PHP	10000	2016	2005	2006
Ben	SEO	20000	2016	2000	2002
Eric	HR	15000	2016	2003	2007

LITERATURE REVIEW

Time and space are omnipresent parts of the real world. Thus, a great deal of endeavors has been put by the scientists to create committed methodologies in the areas of spatiotemporal databases. From the past we found that the research and the scientist shows interest in the field of spatio-temporal databases have been increased where time, space or both need not be available as top of the line ideas to successfully bolster the focus on application. The per user is welcome to consider the data frameworks of such shifted associations as money related establishments, open organizations, processing plants, healing facilities, ecological offices, media outlets, space offices, schools or colleges, to name a few. Spatiotemporal informational collections fundamentally discover changing estimations of spatial and temporal characteristics over a time allotment. A large area of the exploration in this database is centered around the execution of existence changing highlights in the database and the less work has been done in applying these spatio-temporal ideas in reality issue [4].

A large section of the space and time oriented data models is already available that have been implemented on the top of the conventional databases. The scientists have applied broad endeavors to display novel systems for successfully overseeing spatiotemporal information. Dominant part of the work here is concentrated upon the execution of the existence changing highlights on the highest point of traditional databases. The contemporary studies focus in the development of spatio-temporal model using open source database system. It ought to be noticed that there is no flawless information which represent the spatio-temporal information [18]. Each spatio-temporal information displays some qualities while noting certain sort of spatiotemporal question, whereas for different kinds of inquiries it may be wasteful.

The database which is only time and space oriented have these essential facts i.e space, time but the variant of these include the application time, system time and bi-temporal time. The space-time dimension which is abundantly applied in spatio-temporal research modelling is application time.

Various papers studied the execution part of the current spatio-temporal data models. Its work thought about its execution of the applications planned utilizing worked in rationale and the hand-coded applications. Hardly any research papers looked at the execution of the spatiotemporal data models. For the implementation of spatio-temporal data we apply different methods on different areas of artificial intelligence and robotics as well. Some papers on spatio-temporal database presented the efficient indexing techniques for the fast execution of the space and time related queries. Spatio-temporal data sets basically catch changing estimations of spatial and temporal qualities over a timeframe. It postures many difficulties in speaking to, handling and breaking down and mining of such datasets because of complex structure of spatio-temporal database and connecting among them in both spatial and temporal measurements.

K K lwin et.al 2012 [21], had explained that quantitative data which is widely used and from quantitative, the qualitative data can be extracted and the change of data and analysis of the data take place. Because of the mind boggling nature of the scene and a large number of pixels expected to depict scenes, it is hard to build a database that could be utilized to separate the data from the pixels. The users upgrade the graphical processing as well as by enabling the handling of genuine data. The data collection is on the quantitative basis so we enhance that by quality performance of the data by establish a bridge in the database for conversion of quantitative in to qualitative.

In 2015, Stefan et.al [22] had proposed the techniques for continuous animated representation of enormous direction information, which empowers the intelligent spatio-temporal filtering methods. These procedures are effective in little database and can adjust the 3D development perception of the methods. It is a structure deter for visual examination applications and systems which isn't intelligent for far reaching and complex spatio-temporal information.

Mohammed Eissa et.al. 2016 [23] had proposed that granular computing data models in light of rough set theory, Artificial Neural Networks, Genetic algorithm and Rough Mereology Theory. A relative examination of assorted learning exposure representation that usage unmistakable data disclosure systems for data pre handling and data mining support which supports to remove the essential helpful markers, to decrease the misdiagnosis rates and to improve the fundamental administration for

medical findings and treatments. The main reason for this exploration was investigated and assessed the proposed models in light of Granular Computing strategy for learning extraction as indicated by various assessment criteria for the order of restorative datasets. Another reason for existing is to make improvement in the edge of knowledge discovery database for managing and learning the granular computing philosophy.

YonSik Lee et.al 2008 [24] had briefly explained the dynamic area or mobility of a moving article. These moving articles relies upon how to examine and process the huge arrangement of spatio-temporal information. In spatio-temporal moving examples, mining strategy is utilized to extract the periodical or consecutive moving examples from the huge set of arrangement in spatio-temporal moving data. This technique gives particular and customized administration to clients through which we uniquely extract the information and utilized for their own purpose.But from this method the continuously moving of an object can be stored in the database and this database can be increased and we used the quality data for the user.

Chengguo Tan et.al. 2017 [25] had assessed that for organizing and managing the data we have support from the spatio-temporal data. This managing of data is featured with time dimension (T), space dimension(S), and property dimension(D). The Spatiotemporal model which includes a geographic object, event and procedure for measuring the events and describe the change that happen in geographical areas. For this we use the logic model of spatio-temporal data model. The geographical changes that marked clearly by the time of production and ends by the completion of the procedure, these are based on the local administrative standards. There is only one main shortcoming of this logic model that it not to represent the data on real time domain.

El-Geresy et.al. 2002 [26] presents this Process Oriented Model in which is used to retrieve the changes which depends on the underlying processes and their interactions between them. They can represent the objects that how they view. Some specific processes are classified according to their successive states of the objects and are explicitly defined. There are many examples which shows the changes and also identifying them.

Allen et.al. 1995 and Edwards et.al 1993 [27] introduced this casual model which is

based on the concept of cause and effect of the temporal relation. Cause always either proceeds or coincides where effect is the start. It also defines the differences between the cause which is generated by the other events. This model is usually used in decision making. In this decision making process, influence diagrams can display the relationships between the elements affecting the decision making.

According to Martin Breunig et.al 2003 [28] there exist many spatial and temporal data models and a number of recent proposals of spatio-temporal data models. There is no consensus over one model. They are very different from one another so they are offering different sets of functionality for different kinds of users. There are various qualities in a data models like completeness, power and easiness of usage. The conceptual quality in models is essential for data models that are used by humans. The design data model is used the conceptual way to elaborate them. Data models that are used for the designing of the spatio-temporal database or in GIS should also be conceptual in order to use interfaces to their users. Conceptual models have some benefits like they only concentrate on the representation of application programmers. And they are minimal concerns for the technical constraints. Therefore, we advocate for the development of conceptual spatio-temporal data models.

As per the Gueting et. al 2000 [29], there are two distinct scientific classifications which are utilized in AI and the database networks. In the AI people group, spatial models are regularly classified into (I) Quantitative models, which are outstanding and usually received in the fields of mechanical autonomy (robotics) and vision; (ii) Qualitative models, which speak to space in a subjective way; (iii) Hybrid models, which are a blend of the quantitative and qualitative models. Hybrid models concur with the neediness guess, proposed by Forbes, which says: there is an issue in independency which is absolutely subjective portrayal of room or shape. Common data models in the database zone incorporate social, object oriented, and object-relational mode

According to Ward and Zheng 1999 [30], data quality depends on a variety of factors like gathering mechanisms, the derivation method in the case of inter and extrapolation, and the variability of the data itself. Visualization may provide an insight into spatiotemporal data quality. It uses five variables for the three spatial dimensions like time and quality on a display screen. Incomplete or contradictory

information in registered data also poses a problem. The later may be alleviated by applying integrity constraints on the contents of the database. Such constraints are in the form of rules, may be either specified by domain experts or can be automatically generated by data mining algorithms on previously recorded data.

Elena Camossi et.al 2009 [31], had explained the numerous spatial and temporal granularities are used for the significant learning from the data which is stored in the database, through the dataset which is utilized to upgrade the information demonstrating adaptability and being instrumented to support the investigation of data. The implementation of granularity poses several problems and one problem is discussed by using the air aviation dataset which is used to solve the in and out problem. The principle reason for this exploration was investigated and possessed the granular computing and it is a strategy for the improvement of database.

Belussi et.al 2008 [32], has researched independently in the temporal and spatial area. The pioneering research deal with temporal granularities, but numerous different recommendations went for formalizing temporal granularities. The event calculus is stretched out to help temporal granularity and indeterminacy, to represent the uncertain temporal occasions at various granularities and is centered around calendric granularities that might be connected to basic calendars. The majority of these methodologies look for a typical premise over which one may reason on numerous granularities in temporal databases.

Singhal et al. 2005 [33], proposed methodology for clustering multivariate time series data. They have calculated similarity between multivariate time series data with batch fermentation algorithm that is based on two factors. First comparability factor is based on vital segment examination and the points between the primary segment subspaces and the second factor is built on Mahalanobis separate recipe at dataset. The principle favorable position of this closeness factor with bunch aging is viable in grouping multivariate time arrangement datasets and has best outcome to existing strategies.

Palma et al. 2008 [34], proposed a new spatial-temporal clustering method for discovering interesting places in trajectories, which is based on speed rather than distance. It requires three parameters. This approach is a variation of DBSCAN, and in addition it is an implementation of SMoT (Stops and Moves of Trajectories) which is known as CB-SMoT (Clustering Based Stops and Moves of Trajectories). All the

implementation had done on weka tool.

Nitta et al. 2014 [35], proposed method for real time event detection, which is based on latitude, longitude, time and text tag in Flickr images. It is two-step event detection processes. Author has defined a class to event by applying SCAN (Structure Clustering Algorithm for Networks) clustering algorithm which is based on graph and for event detection author has taken similarity of time and text tag of image. Experimental result shows that it is efficient approach to detect the event from small amount of images.

Shi et al. 2014 [36], proposed an extension of DBSCAN to cluster places in geo social network which are visited by users. This method has considered socio spatial information between users who visit the clustered places. DCPGS (Density-based Clustering Places in Geo-Social Networks) requires five input parameters. This method is applied on real dataset and result shows that DCPGS algorithm can cluster millions of places within a few seconds.

Sutanto et al. 2014 [37], introduced ranking based constrained document clustering method to deal with large dataset problem. According to the authors, they have applied semi incremental procedure to make the algorithm faster and more efficient in terms of memory consumption. For document ranking, they have chosen the criteria of vicinity of best cluster instead of applying distance criteria between documents. Experimental result shows that this approach provides good accuracy and requires less memory.

Mark Harroweret.al 2000 [38], made a geographic representation instrument to help Earth Science Learning. It is intended to help finding out about worldwide climate. In this device they utilized temporal centering and temporal brushing. It demonstrates both direct and cyclic changes by delivering dynamic and interactive map animation. The tool gives a chance to investigate the complex spatial and temporal parts of constant evolving wonders. They surveyed their tool dependent on center gathering results.

JUSTIFICATION FOR SELECTION OF RESEARCH AREAS/TOPIC

I choose research area- DBMS & Research Title-**"Design and Devlopment of Advanced Spatio Temporal Database Models with Comperative Study in Existing Models"** because There is more scope .

RESEARCH OBJECTIVES

Motivation for the Research: The main contribution of this work is an expansion of relational database to represent the variety of objects and fields after some time just as occasions. Numerous information types and capacities can catch the progressions in numerous regions, including area based administrations, general wellbeing, environmental and natural disaster observing. The displayed model for example relational model begins with the perceptions however the research attracts attention regarding the significance of utilizing the geospatial applications and perceptions are our way to survey the spatio temporal information in reality. The principle capacity of the spatio-temporal database relies upon the perceptions, whose semantics is physically grounded in procedures and scientifically understood by the examination tools which we utilized. The proposed information is extensible; it characterizes the information types as a building blocks. We utilize three data types for building the perception of the spatio-temporal database: time arrangement, direction and coverage zone. We can build objects and events by utilizing these three information types. The events contain the data about when and where the event happened and the articles are associated with these events during that time span.

The proposed research work Objectives are as follows:

- To Compare Existing Spatio Temporal Database Models.
- To analysis various issues in the management of Spatio temporal database.
- To Devlope a new query optimizing technique for the effective retrieval Of spatio-temporal data.
- Design and Devlopment of Advanced Spatio Temporal Database Model.

RESEARCH METHODOLOGY

Research methodology is the systematic and practical approach to conducting a research study.

In this study Apache open source framework will be used in which helps in Executing large Dataset. An environment is essential for working of Hadoop framework which provides the distributed storage and their computation across clusters. It expects to extent from single server to a large number of machines, each giving local calculationand capacity.

Our Research will be Conducted as per mentioned below:

Step1: - L**oading raw data into the root directory of HDFS.**

Command: Hadoop fs-put/home/cloud era /DelayedFlights.csv/

Step2: -**Pre-processing using Pig**

This is also known as data cleansing phase. As the file is comma separated, we will register and use piggybank.jar in order to use the CSV Excel Storage class. We will make three aliases of actual data namely A, B and C. In relation A, we are loading the data using CSV Excel Storage because of its effective technique to handle double quotes and headers. In relation B, we are generating the columns that are required for processing and explicitly type casting each of them. In relation C, we are filtering out the null values if any, from the generated columns. The pre-processing steps might look easy, but it is one of the major steps in any of the production level projects as the data might not always be properly structured and also you may not need all the columns to perform your analysis. Considering complete columns even when it does not have any role in the analysis will only lead to increased processing time.

Step3: - **Loading pre-processed data from pig to hive using HCatalog**

Once the data is cleaned, we need to transfer it to process and gain insights. We will be using HCatalog and sending the cleansed data directly from pig to hive using it. Now to load the hive data in to pig, Pig uses HCataLoader() function and it looks A=LOAD‘table_name’USINGorg.apache.hive.hcatalog.pig.HCatLoader(); As our table name is olympic, relation looks like this: A=LOAD ‘aviation’ USING

org.apache.hive.hcatalog.pig.HCatLoader(); But before loading data into hive we need to start hive meta store service. Command: hive–service meta store Next, we create a hive table with the same schema as we had pre-processed in the Pig.

Step 4: **Processing the data using Apache Hive**

```
hive> create table aviation(
    > year INT,
    > month INT,
    > flight_num INT,
    > origin STRING,
    > destination STRING,
    > cancelled INT,
    > cancel_code INT,
    > diversion INT)
    > ROW FORMAT DELIMITED FIELDS TERMINATED BY ',' STORED AS TEXTFILE;
OK
Time taken: 3.997 seconds
```

Fig.: Create table in aviation

Step5: **Data Visualization**

The connection of Hive with tableau is to visualize the data and generate reports if we want to understand in deep. The visualization of data at different time intervals is the temporal data and this change can take place at different destinations called the spatial change. The change which is randomly take place can illustrate the data and explains the next destination which is most visited. From the data visualization of spatiotemporal database we analyze the whole dataset which is considered for the most visited destination and the delays occur in the destination due to some reasons like bad weather and other natural disasters. The spatial data will predicts that which is useful for the analysis of the data in future.

Fig: Analysis of the data using tableau of most visited cities

The analysis shown above of the most five visited destinations which we consider in our data set explains the whole scenario by using the tableau.

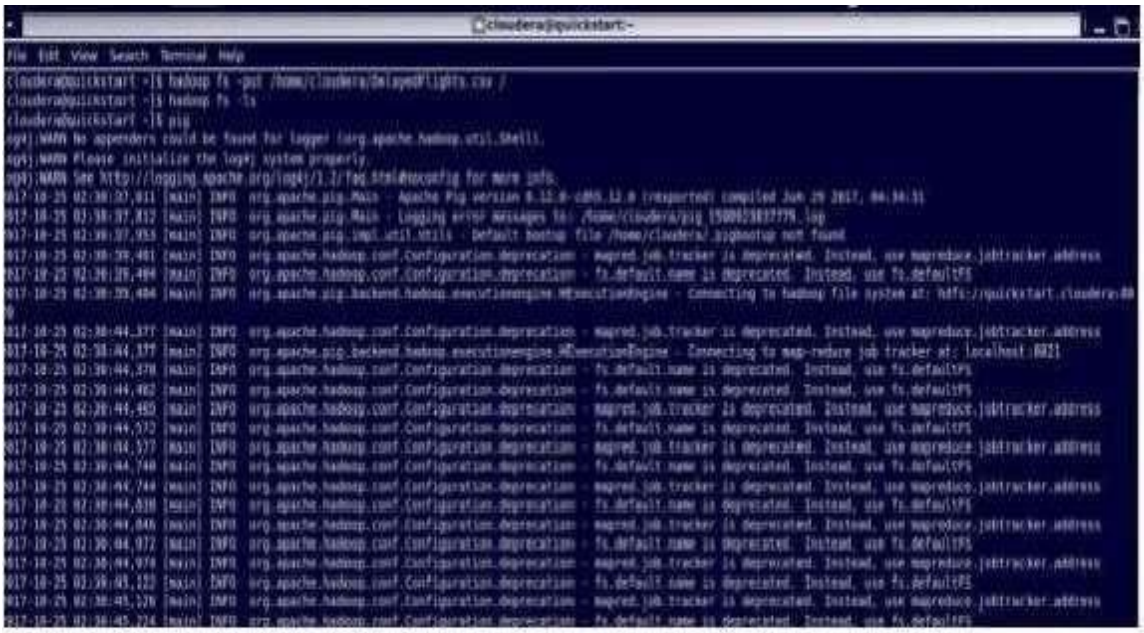

Fig.: Transfer of Data

The above figure, shows the transfer of aviation dataset which is successfully transfer into HDFS system. A method for dissecting the information was detailed which achieved a prerequisites and determination on what might be required so as to

do the examination. In this way, the segments which are required for the examination are done for those exercises which are helpful in the investigation of the information. A system is used to support the analysis was then built and the data loaded. By transferring of data which is available is used to analyze the data and were developed to made available for use.

Flowchart of the Proposed System as mentioned below:

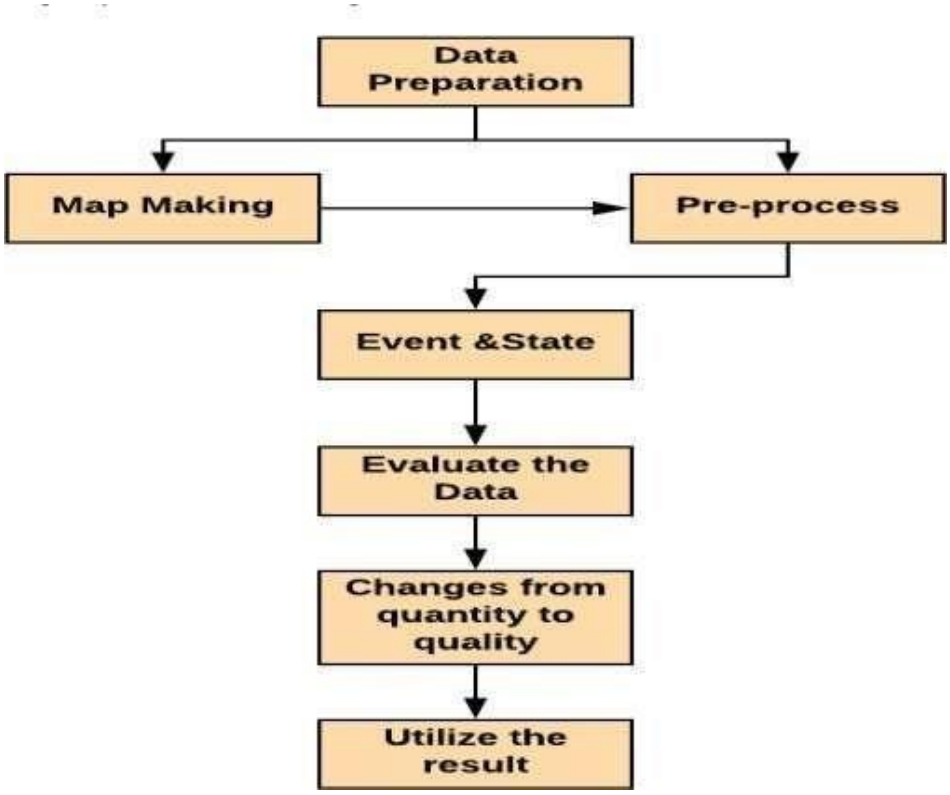

Figure : The Workflow process of research

PUBLICATIONS

Author:- GARIMAJOLLYet al.

Publish_year: 2020

Papertitle:- Cascaded segmentation-detection networks for traffic sign

Purpose:

- To the investigate the role of financial & financial autonomy.
- To evaluate the important research direction for the TSDR automatic area n categorized the main approaches in various portions in so as to be ableto readily understand.

Author:-GARIMAJOLLY et al.

Paper title:-Role of Artificial intelligence the development of innovation

Publish_year: 2023

Purpose:

- This study mainly focuses on the future prospects of AI in various fields of Industries and suggests the prospective areas in which AI could be implemented in order to obtain most functionality.
- To evaluate the Application of AI in various businesses ultimately results in a win-win situation for both the businesses and as well as the customers possible strategies. As AI brings out the best services through innovative technologies and strategies.

SAMPLE RESEARCH PLAN OF MINIMUMTIME LINE

ResearchActivity	**6**	**12**	**18**	**24**	**30**	**36**	*****
1. Course Work							
2. Literature Survey							
3. Methodology Steps							
4. Quarterly Reports							
5. Communication of Papers							
6. Preparation of final thesis							
7. Submission of thesis							

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